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INVESTIGATION OF DETERIORATION OF DRILLS WITH TREATMENT OF STEE--ETC(U)

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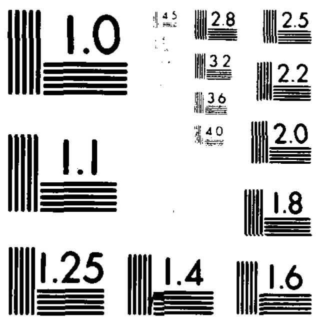

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FOREIGN TECHNOLOGY DIVISION

INVESTIGATION OF DETERIORATION OF DRILLS
WITH TREATMENT OF STEEL EI654

by

L. Sh. Shuster

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

INVESTIGATION OF DETERIORATION OF DRILLS WITH TREATMENT OF STEEL EI654

L. Sh. Shuster

The present work was conducted with the purpose of establishing optimal modes of cutting in the treatment of heat-resistant and acid-resistant steel EI654 with drills made of fast-cutting steel R18 (GOST 888-60). Here, we used shortened drills with a diameter of 15 mm, possessing increased resistance to vibration $(\frac{l}{D} \leqslant 8)$.

Strength tests were accomplished on the machine tool model 2A135 with the following modes of cutting: s=0.10; 0.17; 0.28 mm/turn and v=4.6; 6.6; 9.2; 12.8 and 18.5 mm/min (cooling of drills was not done). We machined blind passages in billets fastened on the table of the machine with the aid of vices.

For measuring the value of deterioration along the rear surface of the drill, we used the MIR-1 microscope with micrometric adapter AM9 fastened in a special attachment. Here, we fixed width h_3 of the streak of wear at a distance of 0.2 mm from the periphery of the cutting edge of the drill. Upon achieving h_3 value of 0.3 mm, the test was discontinued and the drill was resharpened on the sharpening tool model 3659A.

Temperature investigations were done by the method of natural thermocouple.

In this work, the deterioration of drills was estimated by the period of resistance T min, the total length L mm of the drilled hole and by the average relative wear

$$h_o = \frac{h_3}{l}, \qquad (1)$$

where l - length of the cutting path;

h_3 - width of the streak along the rear surface of the drill, corresponding to length l.

Observations of wear of drills showed that it occurs basically along the rear surface, in which regard its value grows from the center to the periphery of the drill, and graphs $h_3=f(l)$ have a classic character: with the period of running in and with the zones of normal and catastrophic deteriorations.

Usually, [1] the period of resistance of the drill T is the initial value with determination of the speed of cutting from expression

$$v = \frac{C_v}{T^m}, \qquad (2)$$

acquired on the basis of test data. As we can see from Figure 1, with drilling of steel EI654 dependence T-v is nonmonotonous and to write it with one formula like the type in (2) is impossible. Moreover, indicator m of the relative resistance depends, also, on value of feed s. All of this makes more difficult the acquisition and practical use of expression (2) in cutting of steel EI654.

Moreover, as was shown in works [2,3], the resistance period T cannot serve as the indicator of expediency of a selected cutting mode. Actually, the number of parts treated with a drill before becoming blunt depends on the intensity of its wear (value h_0) and is determined by the total length L of the drilled hole (with an assigned diameter of the drill).

The dependences $h_0=f(v)$ presented in Figure 2 for various feeds have identical extremal character from the point of minimum at optimal speeds of cutting v_0 [2] and equal optimal temperature of cutting $\theta_0=500°C$. At cutting temperatures less than θ_0, the adhesion wear of drills [3] is predominant, which for fast-cutting tools is changed little in connection with the change in cutting temperature [4]. Therefore, the left branch of curves $h_0=f(v)$ is extremely flattened. At cutting temperatures greater than θ_0, diffusion wear of drills [3] is predominant, which for fast-cutting tools begins to appear at 500-550°C and intensifies with its increase in view of the fact that the speed of diffusion is connected with the temperature of exponential dependence [4]. Therefore, we can say that the right part of curves $h_0=f(v)$ reflect, by their nature, the influence of cutting temperature.

A comparison of speeds v_0 with the economic* $v_э$ showed that they practically coincide according to value (the difference is no more than 5%). Thus, with treatment of steel EI654 with drills made of R18, is it most rational to designate the speeds of cutting equal to v_0, since here, during the period of resistance of a drill, we can treat the largest number of parts with with lowest expenditures. From Figure 2 it is apparent that the optimal speeds of cutting v_0 which correspond to an increase in s decrease (but the temperature of cutting v_0 remains practically identical by value). A change in speed v_0 is such that the technological productivity, equal to

$$\Pi_0 = 10 v_0 \cdot s \ см^2, \quad (3)$$

increases with an increase in feed (Figure 3). This stimulates, with drilling, the designation of possible feeds and optimal speeds of cutting which correspond to them.

Here, as follows from Figure 3, before feed of 0.17 mm/turn, not only the cutting productivity increases, but the total length L_0 of the drilled hole increases, and, consequently, consumption of the dutting tool decreases. In feeds greater than 0.17 mm/turn, we observe in drills with a diameter of 15 mm strong adhesion of shavings to the drill, which hampers shaving-removal and leads to intensification of wear of the drill and a decrease in length of treatment L_0.

Therefore, drilling of steel EI654 with the use of a drill with a diameter of 15 mm must be done on feeds of about 0.17 mm/turn and at cutting speeds v_0, determined from expression

$$v_0 = \frac{4}{s^{0.42}} \ м/min \quad (4)$$

CONCLUSIONS

1. The earlier-established invariability of optimal temperature of cutting relative to feeds and speeds of cutting with sharpening, boring and milling of construction materials [2] found support, also, with treatment of steel with drills made of fast-cutting steel R18. This substantially expands the capabilities of use of temperature investigations for determining optimal conditions of cutting with

*We call economic a speed of cutting which ensures, with treatment of conditional parts, the lowest value of changing fraction of cost.

drilling.

2. With determination of the speed of drilling, we must begin not with the resistance dependence (2), but from expression (4), which preliminarily designates the maximum possible feed. Here, during the period of resistance of the drill, we will treat the maximum number of parts with the lowest costs.

3. With treatment of steel EI654 with fast-cutting drills of R18 with a diameter of 15 mm, it is most rational to designate feeds about 0.17 mm/turn.

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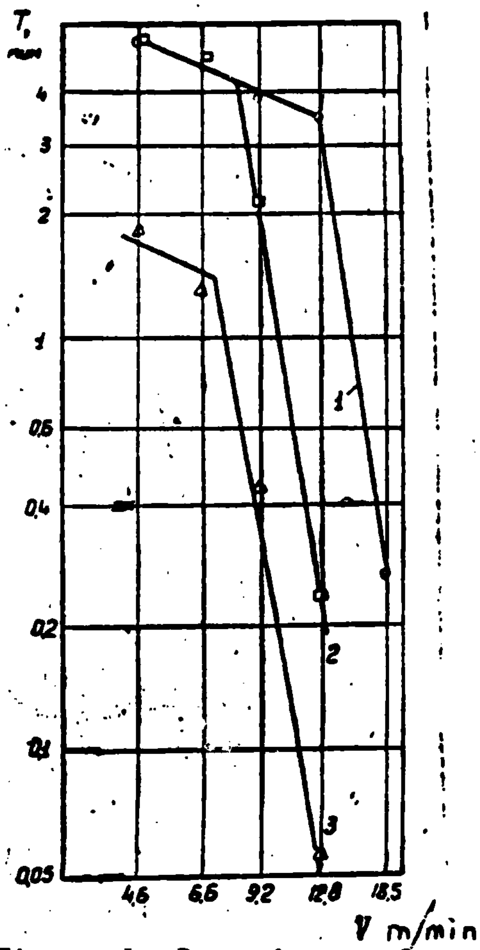

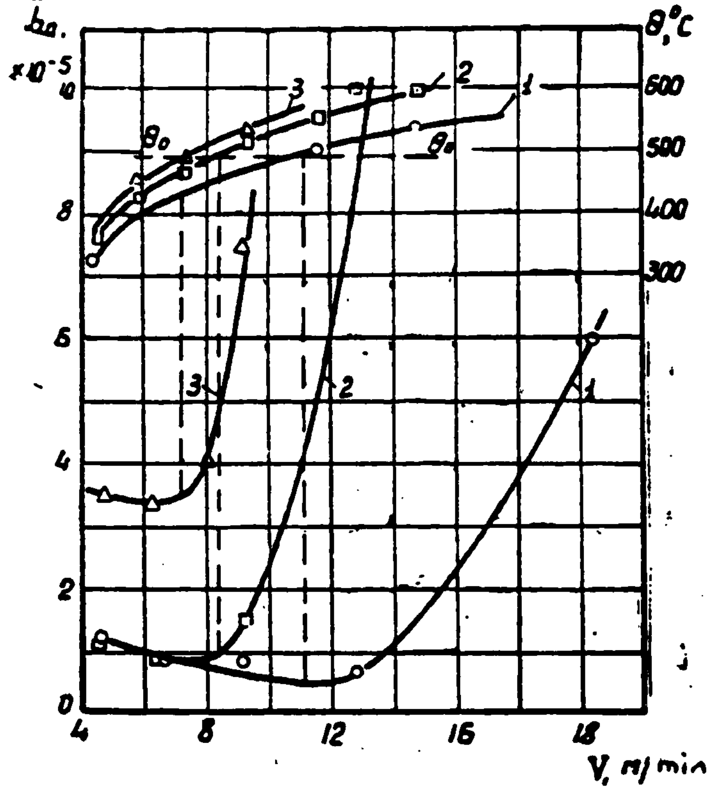

Figure 1. Dependence of period of resistance on speed of cutting and feed: 1) S=0.1 mm/turn; 2) S=0.17 mm/turn; 3) S=0.28 mm/turn.

Figure 2. Influence of speed of cutting and feed on average relative wear of drills and temperature of cutting: 1) s=0.1 mm/turn; 2) s= =0.17 mm/turn; 3) s=0.28 mm/turn.

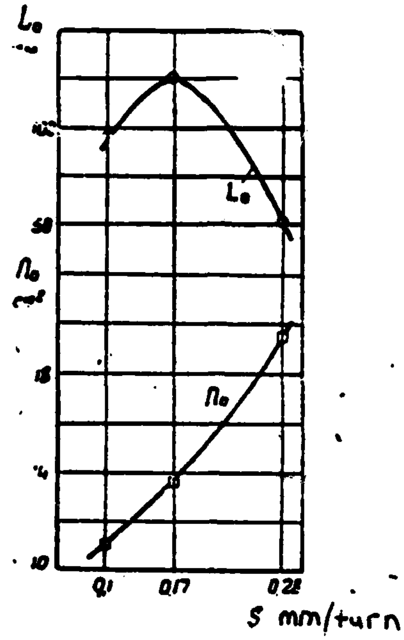

Figure 3. Technological productivity and total length of drilling depending on the feed with work at optimal speeds of cutting.